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Der Präsident des Europäischen Patentamts;
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Oriented strand boards (OSB) comprising a new resin composition

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ORIENTED STRAND BOARD (OSB) COMPRISING A NEW RESIN COMPOSITION

The invention is directed to an Oriented Strand Board (OSB) comprising a new resin composition.

The oriented strand boards that are commercially prepared at the moment comprise a core layer of wood strands combined with resin covered by two face layers of wood strands combined with an other resinous material.
The strands in the OSB can have the following dimensions; length between 5 and 150 mm, width between 1 and 50 mm and thickness between 0.1 and 2 mm.
The core can form between 10 and 90 % of the OSB, preferably between 40 and 60% of the board.

The core layer comprises as the resin 2-6 wt% (dry resin/dry wood) of an polymeric methylene diphenyl diisocyanate (PMDI) or a phenol formaldehyde resin (PF) and the face layers comprise a melamine-urea-formalydehyde (MUF) resin that may also comprise a small amount of phenol or a phenol formaldehyde resin or pMDI resin with a release agent added thereto. The face layers have a resin content of typically 9-12 wt% dry resin/dry wood for MUF and typically 2-6 wt% dry resin/dry wood for PF.

These boards meet the requirements of OSB/3 in the EN 300 standards.

It is now surprisingly discovered that an OSB meeting the OSB/3 standards can be made with a much lower amount of resin in the face layers when another type of resin is used.

A special resin composition has been developed according to the invention.

The resin composition comprises melamine, formaldehyde, optionally urea and aromatic hydroxyl compounds, where in the resin composition the molar ratio of melamine to formaldehyde is 1:0.8-4.0, the molar ratio of melamine to urea is 1:0-2.0 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0.

By application of this resin for the preparation of the face layers of the OSB the amount of resin that has to be used for the face layer to make a board that meets the OSB/3 standards is only 2.5-8 wt% dry resin/dry wood.
As a result of this the cost price of the OSB will be lower than for a commercial board as described above.

The resin composition according to the invention comprises melamine and formaldehyde. The melamine and formaldehyde are present in the resin composition in a molar ratio of 1:0.8-4.0, preferably 1:1.0-3.0.

The resin is normally made by mixing dry melamine powder with an aqueous solution of formaldehyde. This solution having a formaldehyde concentration of for instance 30-55 wt% of formaldehyde.

Further the resin composition can contain urea and/or aromatic hydroxyl compounds.

When urea is present in the resin composition the molar ratio of melamine to urea is 1: 0-2.0, preferably 1:0-1.5. When aromatic hydroxyl compound is present in the resin composition the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0, preferably 1:0-1.0.

Examples of aromatic hydroxyl compounds are resorcinol, hydrochinon or bisphenol A. Preferably phenol is used as the aromatic hydroxyl compound.

The urea can be introduced in the resin composition by adding solid urea or by adding an urea solution in water and mixing it with the melamine and the formaldehyde solution. Also an aqueous solution of formaldehyde and urea can be used in combination with the melamine powder.

Phenol can be added as such when the resin composition is prepared or as a formaldehyde/phenol precondensate.

The components that make up the resin composition are added to each other and mixed at a temperature of 20 to 40 °C. Thereafter the temperature is raised to a temperature between 70 and 100 °C. The pH-value of the mixture is preferably between 7.0 and 10.0. Under these conditions the mixture is condensed until the viscosity of the resin composition is between 10 and 1000 mPas, preferably between 10 and 500 mPas. Thereafter the resin composition is cooled to 20-75 °C, preferably to room temperature.

The pH of the cooled resin composition will be between 7 and 10.

An other method for preparation of the resin composition is stepwise dosing of the components. For example, urea can be added during or after the condensation.

To adjust the pH of the resin composition the normal additives to create alkaline conditions can be used, like alkali or earth alkalihydroxydes, preferably in the form of their aqueous solutions, tertiary amines, like for instance tributylamine or triethylamine, or tertiary alkanolamines, like for instance triethanolamine and

methyldiethanolamine.

The viscosity of the aqueous resin composition is at 20 °C 10-800 mPas and has a solids content of between 60 and 70%.
The products can be stored for a couple of weeks at 20 °C.
Small amounts of other additives can also be added to the resin.

The resin composition according to the invention has surprisingly good properties when applied as the resin in the face layers of oriented strand board (OSB).

To be applied in the face layer the resin has to be mixed with a catalyst or hardener to make an adhesive composition. As a hardener for instance ammoniumsulfate is used in an amount of up to 5 wt% dry hardener/ dry resin. Other hardeners can also be used; for instance ammonium chloride or ammonium nitrate.

During the adhesive preparation also waxes can be applied to enhance the moisture resistance of the OSB.

After addition of the catalyst the adhesive composition is used within a time frame of a few hours in the production of an OSB.

The adhesive composition is sprayed on the wood strands to coat the wood strands with it. The adhesive composition is hardened when heated, thus binding the wood strands to each other. Heating and hardening takes place when pressing the final board material.

The process for the production of an OSB is for instance described in: "Holzwerkstoffe und Leime, M. Dunky and P. Niemz, Springer-Verlag, 2002."
A method of making the oriented strand boards according to the invention is by spraying the resin composition according to the invention onto the wood strands for the face layers of the OSB. The amount of resin in the face layer should be 2.5 to 8 wt% dry resin/dry wood.

The core material is also made by coating the wood strands for the face layer with the normally used polymeric methylene diphenyl diisocyanate (PMDI) or phenol formaldehyde (PF) resin or with an other resinous material, for instance with the resin composition according to the invention. When the resin composition according to the invention is used in the core layer instead of PMDI the amount of resin can be about the same as for PMDI or lower in the core layer, so that the costs for the resin in the core layer are lower.

Thereafter an OSB is prepared by first scattering the face layer

material, thereafter the core layer material and then again a layer of face layer material and hot pressing this to an OSB. The pressing can be continuous or batch wise. In the core layer and the face layers wood strands of different size and orientation can be used.

The press conditions are 1-7 MPa, 150-270 °C during 3-12 sec/mm, preferably 5-10 sec/mm.

The face layer of the finished OSB comprises an amount of urea of 0-0.025 kg/kg face layer, preferably 0-0.015 kg/kg face layer. The amount of urea in the face layer can for instance be determined with Raman spectroscopy and with solid state NMR.

The finished OSB according to the invention meets the requirements for an OSB/3 material as are laid down in the EN 300 requirements. Typical requirements herein are the requirements for thickness swelling and internal bond after boiling.

The thickness swelling is determined according to EN 317 and must be lower than 15% for an OSB/3 board.
The internal bond after boiling is determined according to EN 321 and EN 319.
The minimum values differ with the board thickness and are:

Board thickness (mm)	Internal bond (N/mm^2)
6-<10	>0.15
10-<18	>0.13
18-<25	>0.12

The invention is elucidated further by means of the following examples.

Example I

Resin preparation

The pH of a solution of a formaldehyde in water and a phenol formaldehyde precondensate were added to each other and stirred. The mixture was adjusted with NaOH to a pH of 9. Melamine was added at room temperature. Thereafter the temperature was raised to 90 °C. dissolution of the melamine and condensation takes place until the water tolerance was 1.5-2. The water tolerance was

determined at 20°C.

Thereafter the mixture was cooled. At 60 °C the urea was added and thereafter the mixture was cooled further to room temperature during stirring.

The resin composition was:

1 mol melamine; 2.1 mol formaldehyde; 0.26 mol urea and 0.16 mol phenol.

The resin properties were:

Viscosity 300 mPas (at 20 °C),

pH = 10,

Solid content = 62.5 %,

Gel time = 50 sec.,

Water tolerance = 1.5

OSB preparation

The adhesive composition for the face layer of the board was made by adding to the resin, the hardener and a wax emulsion. Than the adhesive composition was sprayed onto the wood strands.

The face layer for the board contained 5.8% dry resin/ dry wood and 1% dry hardener/dry resin.

The adhesive composition for the core layer was also sprayed on the wood strands. The core layer for the board contained 3.0% dry PMDI/dry wood. Thereafter a board was made by scattering a layer of the wood strands for the face layer, than scattering a layer of wood strands for the core layer and thereafter again scattering a layer of wood strands for the second face layer.

The ratio core layer to face layers was 50/50.

The board was pressed with a press factor of 9.4 sec/mm, an average temperature of 235 °C and a pressure of 5 MPa.

An OSB was made with a thickness of 22 mm having a thickness swell of 9.1% and an internal bond value of 0.16 N/mm2.

Example II

With the same method as described for example I an OSB was made with a thickness of 18 mm. For this board the face layer contained 6.0% dry resin/ dry wood and 1.5% dry hardener/dry resin.

The board was pressed with a press factor of 9.2 sec/mm, an average temperature of 235 °C and a pressure of 5 MPa.

An OSB was made with a thickness swell of 11.7% and an internal bond value of 0.16 N/mm2.

CLAIMS

1. Oriented strand board (OSB), comprising a core layer covered by two face layers, characterised in that the resin in the face layer is a resin composition comprising melamine, formaldehyde, optionally urea and aromatic hydroxyl compounds, wherein the molar ratio of melamine to formaldehyde is 1:0.8-4.0, the molar ratio of melamine to urea is 1:0-2.0 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0.
2. Oriented strand board according to claim 1, characterised in that in the resin composition the molar ratio of melamine to formaldehyde is 1:1-3.0, the molar ratio of melamine to urea is 1:0-1.5 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-1.0.
3. Oriented strand board according to claim 1 or 2, characterised in that the aromatic hydroxyl compound is phenol.
4. Oriented strand board according to any one of claims 1-3, characterised in that, the resin in the core layer is the same as the resin in the face layer according to any one of claims 1-3.
5. Oriented strand board according to any one of the claims 1-3, characterised in that the amount of resin in the face layer is 2.5-8 wt% dry resin/dry wood.
6. Oriented strand board according to any one of claims 1-3 or 5, characterised in that the amount of urea in a face layer is 0-0.025 kg/kg face layer.
7. Oriented strand board according to any one of claims 1-3 or 5, characterised in that the amount of urea in a face layer is 0-0.015 kg/kg face layer.
8. Oriented strand board according to any one of claims 1-7, characterised in that the OSB has a thickness swell lower than 15% according to OSB/3 standards.
9. Oriented strand board according to any one of claims 1-8, characterised in that the OSB has and an internal bond value after boiling that is according to OSB/3 standards.

ABSTRACT

Oriented strand board (OSB), comprising a core layer covered by two face layers, characterised in that the resin in the face layer is a resin composition comprising melamine, formaldehyde, optionally urea and aromatic hydroxyl compounds, wherein the molar ratio of melamine to formaldehyde is 1:0.8-4.0, the molar ratio of melamine to urea is 1:0-2.0 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0.

The board meets the OSB/3 standards.